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SOME NOTES ON FORMALIN.

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The discussion on Formalin at Ithaca showed so much interest is felt in it as to justify the publication of some particulars not generally known. The name Formalin is a trade mark of E. Schering by which a 40% solution of Formaldehyde in water is indicated.[1] Formaldehyde, $C H_2 O$ is a gas at ordinary temperatures, and was first made by A. W. Hofmann, as stated by him in a communication to the Royal Society, Sept. 30, 1867, in the following words.

''A substance possessing the composition and properties of methylic aldehyde is formed with surprising facility if a current of atmospheric air, charged with the vapor of methylic alcohol, be directed upon an incandescent platinum spiral.''

It may also be made by Tollen's[2a] method of passing by means of an aspirator the vapor of methyl alcohol mixed with air through a tube filled with copper gauze, having the ends stopped with asbestos, and heated in a water bath. The product is drawn through four flasks of which the first two are empty, the second filled with water and the third with a solution of ammonium carbonate. About 40% of the methyl alcohol is transformed, and the remainder can be separated by distillation. Trillat[3] has recently made a lamp on the principle of the above apparatus for burning methyl alcohol and developing formaldehyde where disinfection is required after diseases such as diptheria, etc., which is said to destroy all germs at the end of eight hours in an ordinary room. A better process for making formaldehyde is that of Michael[4] which consists in heating in a closed flask monochlormethyl acetate and water to 100 C. for an hour, care being taken to avoid excessive pressure. The contents are neutralized with sodium hydrate and distilled on an oil bath giving an aqueous solution of 17 to 18% of formaldehyde. By evaporating in vacuo till trioxymethylene begins to form a solution of 40% is easily obtained. Formaldehyde exists in three modifications, monomolecular in dilute solutions, dimolecular or metaformaldehyde in concentrated solutions, and as a solid almost insoluble in water known as paraformaldehyde or oxy-methylene[2c]. In speaking of the strength of solutions, care should be exercised to keep the meanings distinct of the two words, formalin and formaldehyde; a one per cent solution of formaldehyde is made by adding thirty-nine parts of water to one part of formalin, but a one per cent. solution of formalin requires ninety-nine parts of water to one of formalin. Formalith is the name of blocks of kaolin and siliceous earth containing fifty per cent. of formalin; formol is the French for formalin, and formal is Methylal, $C_3H_8O_2$ quite a different thing.

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[1] Schering, Trade Circular 55 Maiden Lane, New York City.

[2] Berichte der deutscheu Chemischen Gesellschaft, [a] 19 p. 2133, [b] 16 p. 1333, [c] 21, p. 3503.

[3] Druggists Circular and Chem. Gazette [a] 1894, 275.

[4] American Chemical Journal, Vol. I, p. 418.

Formaldehyde may be detected and estimated by the methods of Legler[2b] and Trillat[1], as follows. To the solution to be tested add a few drops of sulfuric acid, then half a c c. of dimethylanilin, shake well and warm for half an hour in water bath, then make alkaline by soda and boil till the smell of dimethylanilin disappears, filter and wash the filter. This filter paper is then laid on a porcelain dish, moistened with acetic acid, and a little finely pulverized lead dioxid sprinkled on it, when if formaldehyde is present, a deep blue color results.

2. Dissolve three Gr. anilin in one liter of distilled water, mix 20 cc. of this liquid with 20 cc. of the fluid to be tested in a test tube, after some hours a white cloud will appear, the time depending on the amount of formaldehyde. One part in 20,000 will show the cloud after some days. The reaction is also given by acetic aldehyde.

Formaldehyde may be determined quantitatively by ascertaining the amount of ammonia necessary to convert it into hexamethyleneamin.[2] First determine the acidity of the solution to be examined by normal soda solution, with phenol phthalein as an indicator. Measure ten cc. of the solution containing formaldehyde in a flask, add an equal amount of water, and ammonia till it smells strongly. Steam is then passed through the flask to carry the uncombined ammonia into a second flask containing water in which excess of ammonia is absorbed, this is measured by normal acid, the result added to the ammonia that would be required to render the solution neutral at first, and the sum subtracted from the total ammonia used. The following equation gives the result.

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[1] Comptes Rendus 116, p. 891. [2] Sold as a uric acid solvent.

$$\underset{180}{6CH_2O} + \underset{68}{4NH_3} = \underset{140}{(CH_2)_6 N_4} + \underset{108}{6H_2O}$$

See for further work in this direction Richmond and Bosely, London Analyst, quoted in Druggists' Circular and Chemical Gazette, 1895, p. 210.

The writer determined the Spec. Grav. of formalin in a freshly opened bottle to be 1.080. On adding an equal volume of water the S. G. became 1.045, hence the hydrometer could be used to determine the strength of aqueous solutions containing only formalin. He also made some trials to see if the well known aldehyde reaction of precipitation of ammoniacal silver nitrate could be used quantitatively by the aid of potassium chromate as indicator of the end of the reaction, but did not complete the work in time for this paper.

Formaldehyde is an essential factor in the production of many dyes, and is an active chemical reagent, hence it is not indifferent to the stains employed in microscopic work. Carmin fades rapidly under its influence, as well as the colors of many natural objects, the expectations of its utility as a preservative of color have not been realized. Hæmatoxylin seems to stand its action well. In its relations to vegetable physiology, it is a very interesting material since it appears that it is the intermediate substance produced by the action of the carbon dioxid of the air on chlorophyll, which is subsequently polymerised to glucose in the plant cells, and it was by its aid that a fermentibte synthetic sugar capable of yielding alcohol was first obtained.[1]

In its full strength formalin mummifies the cuticular tissues by repeated application and hence may possibly be used for the removal of abnormal growths, such as warts, etc., it hardens hides to a kind of leather, and although destructive to germ life, and irritating to some people, its vapors do not appear to injure the workmen employed in its manufacture.[1]

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[1] Loew Ber. 22, 475, Am. Jour. Phar. 1891, p. 403 ; Jour. London Chem. Soc. Abs. 1892, 1259.

Formalin has been used by Dr. Alleger and others in cases of diphtheria as a spray in solutions of from one to five per cent. of formaldehyde. The stronger solution would cause momentary distress but not lasting pain, it proved more effectiəv, and also more irritating than mercuric chlorid. In seven out of eight cases two or three applications of a one per cent. solution of formaldehyde caused disappearance of the exudate without other treatment. In a mixed infection it was not so prompt, and was alternated with bichlorid, and also with hydrogen peroxid boiled down to half bulk and afterwards diluted as the case progressed, and accompanied with permanganate of potash one-half per cent. ; solution mercuric chlorid was employed as high as 1—500 without injury. The degree of success obtained by these remedies in this dreaded disease seems to justify their prompt and judicious use, in preference to the caustic medicines sometimes employed.

A quarter per cent. formaldehyde solution has been successfully used to spray walls, etc., and by an atomizer to disinfect generally the air of rooms, and the formalin itself may be evaporated as a substitute for burning sulfur where contagion is suspected, the gaseous form and penetrating character of formaldehyde rendering it particularly suitable for this purpose.

Further information on the chemistry of formaldehyde may be found in Smith's translation of Richter's Organic Chemistry, second American edition, 1891.

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[1] Schering, Trade circular.